A Successful Story of Collaborative Research at a Hispanic Serving Institution



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The University of Texas at Brownsville





MU-SPIN 10th Anniversary User's Conference

MURED 2nd Annual Education Conference

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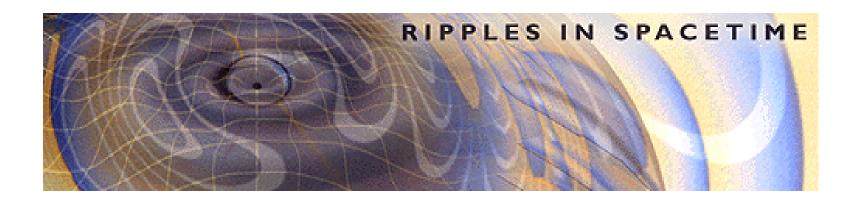
September 11-16, 2000



- The youngest component of the U T system.
- About 9500 students. 90% Mexican-Americans.

- 1998 NASA, Faculty Awards for Research. *Wave Profiles in Gravitational Radiation Astronomy*. NASA-JPL contract No 961298;1998-2000 (\$207,000).
- This grant made possible:
- to start a vigorous research program in the area of gravitational wave detection.
- Initiate a collaboration with other universities (Penn State, University of Wisconsin, Caltech, MIT).
- Attract good talented students to the Physics program.

What are Gravitational Waves?



Predicted in Einstein's General Theory of Relativity, gravitational waves are disturbances in the curvature of space-time caused by the motions of matter.

- Propagating at (or near) the speed of light, gravitational waves do not travel "through" spacetime as such -- the fabric of spacetime itself is oscillating.
- Though gravitational waves pass straight through matter, their strength weakens proportionally to the distance traveled from the source.
- A gravitational wave arriving on Earth will alternately stretch and shrink distances, though on an incredibly small scale -- by a factor of 10^{-21} for very strong sources.
- That's roughly equivalent to measuring a change the size of an atom in the distance from the Sun to Earth!

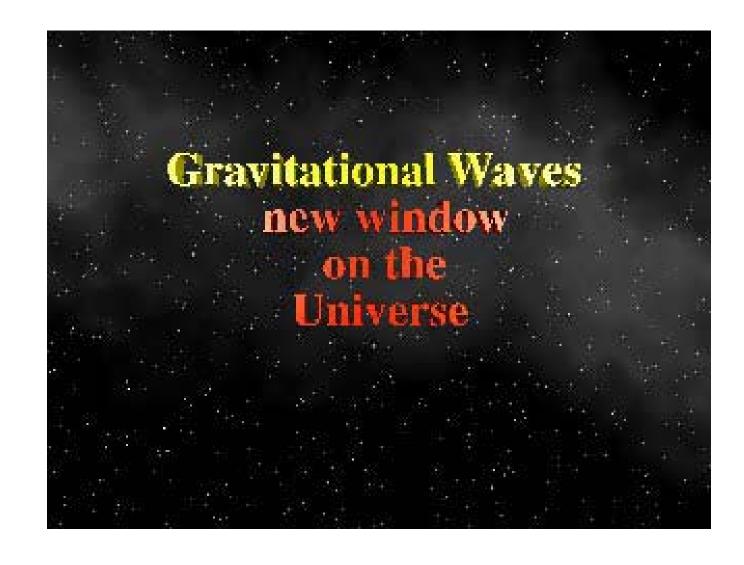
Are Gravitational Waves real?

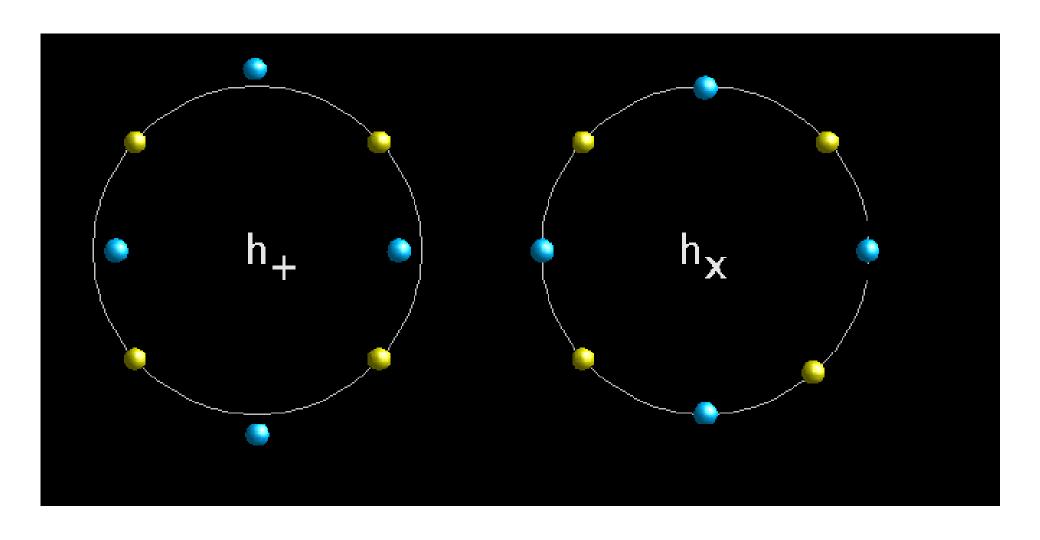
- In the mid 1970s, American researchers observed a binary pulsar system (named PSR1913+16) that was thought to consist of two neutron stars orbiting each other closely and rapidly.
- Radio pulses from one of the stars showed that its orbital period decreases by 75 microseconds per year.
- In other words, the stars are spiralling in towards each other -- and by just the amount predicted if the system were losing energy by radiating gravity waves.

Why Should We Care About Gravity Waves?

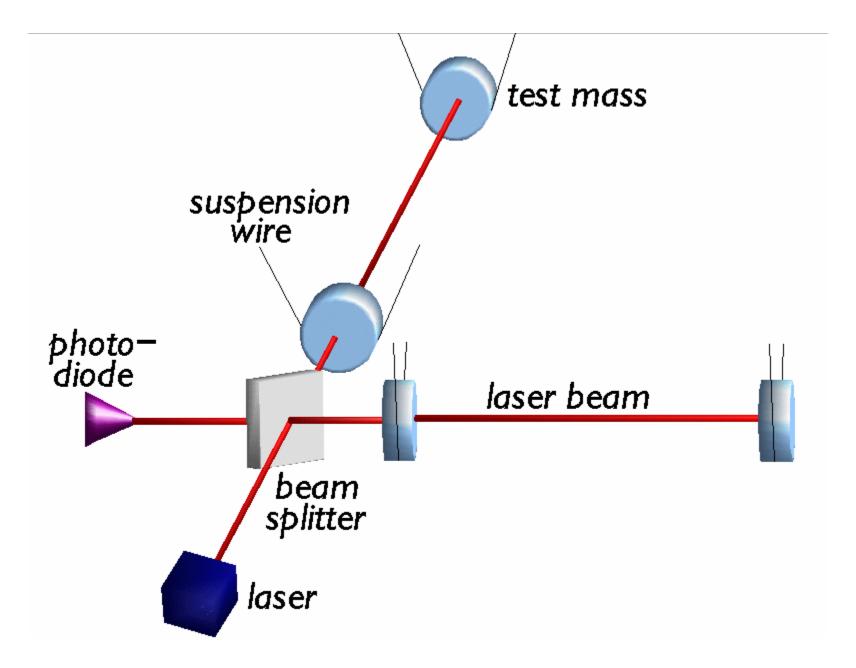
- Gravitational wave astronomy could expand our knowledge of the cosmos dramatically.
- For starters, gravitational waves, though weakening with distance, are thought to be unchanged by any material they pass through and, therefore, should carry signals unaltered across the vast reaches of space.
- By comparison, electromagnetic radiation tends to be modified by intervening matter.

- Aside from demonstrating the existence of black holes and revealing a wealth of data on supernovae and neutron stars, gravitational wave observations could also provide an independent means of estimating cosmological distances and help further our understanding of how the universe came to be the way it looks today and of its ultimate fate.
- Gravitational waves might unveil phenomena never considered before. Nature can surpass any ivory tower theorist trying to imagine or calculate what might be out there!





Test masses moving under the effect of a passing gravity wave.



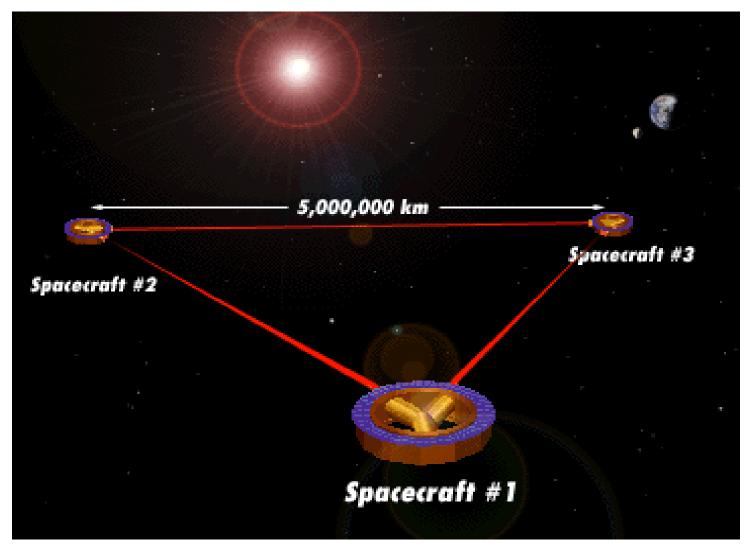
Schematic of a Laser Interferometer for Gravitational Wave detection. (picture by Warren Anderson, UTB)



LIGO Hanford (WA) Observatory



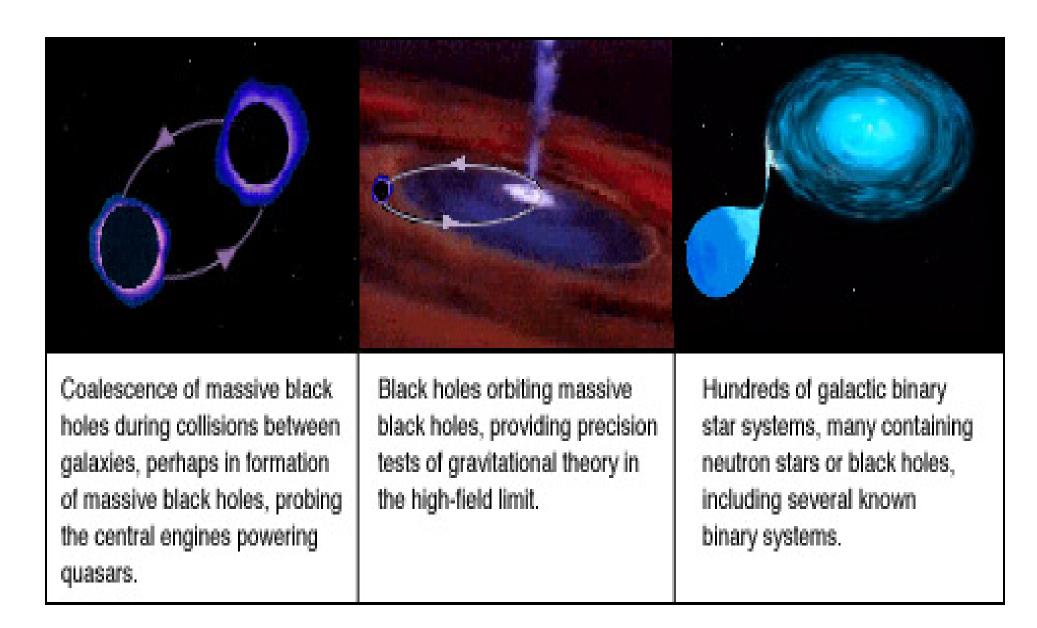
LIGO Livingston (LA) Observatory



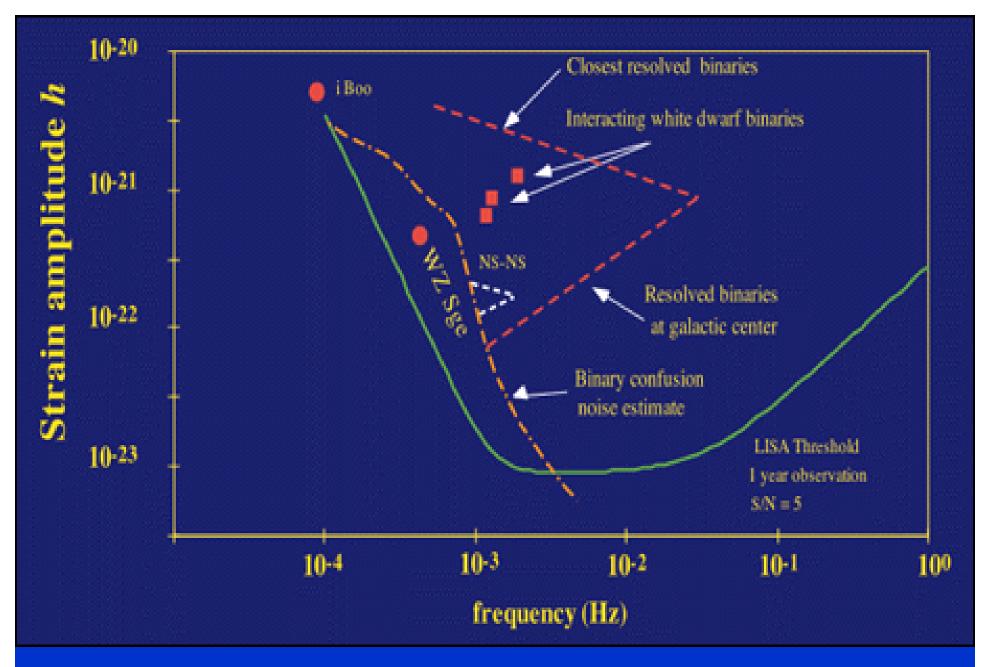
LISA Laser Interferometer Space Antenna.





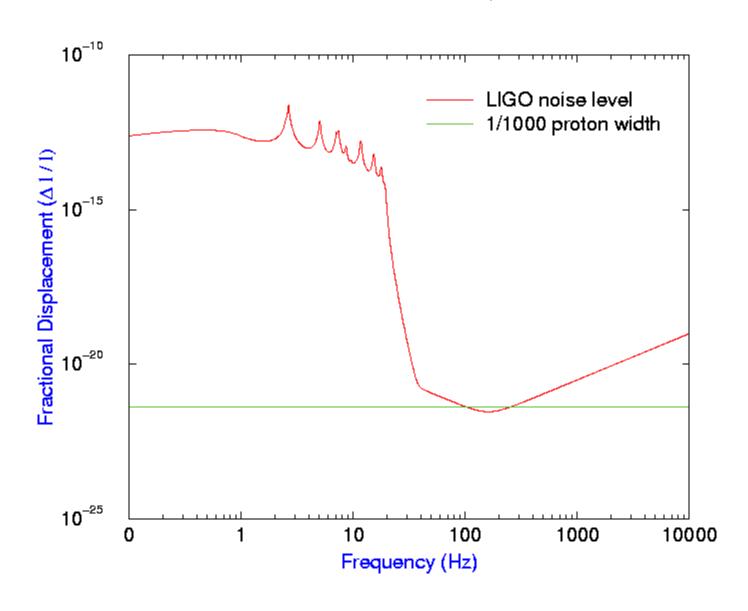


LISA sources



The sensitivity curve for LISA

Noise Levels in Inital LIGO



Current Status of the program

- Grant from NSF awarded: *PHY-9981795 Collaboration* to Integrate Research and Education between UTB and LIGO \$1 million.
- The Relativity Group (UTBRG) has three professors (J. Romano, W. Anderson), one post-doc (John Whelan), several undergraduate and graduate students.
- Two new programs have started: B.S. in Engineering Physics and a Master in Physics, collaborative program with UTEP.
- The UTBRG is an official and active member of LSC (the LIGO Scientific Collaboration)

- The UTBRG is responsible for developing the tools for the cross-correlation statistics to search for the stochastic background.
- A BEOWULF cluster with 128 processors for binary inspiral searches is under construction.
- Six students and three professors spent part of the summer in research activities at the LIVINGSTON Observatory.
- The first graduate course (Introduction to General Relativity and Gravitation) is currently being offered at UTB with students from UTEP also taking it through video conference.

- Five students have graduated with a B.S. in Physics and direct support from NASA. About five more will graduate with degrees in Engineering and Computer Science.
- •UTB is part of a group of universities led by the University of Florida and the University of Chicago that recently submitted a proposal to develop a computational network (GRIPHYN). The purpose to analyze large amount of data to be generated in several areas of Physics and Astronomy.
- If the grant is awarded UTB will receive close to \$500.000 over five years.



MURED Minority University Research



- Quality Research
- NASA support.
- Institutional commitment.